

Space for the Arctic



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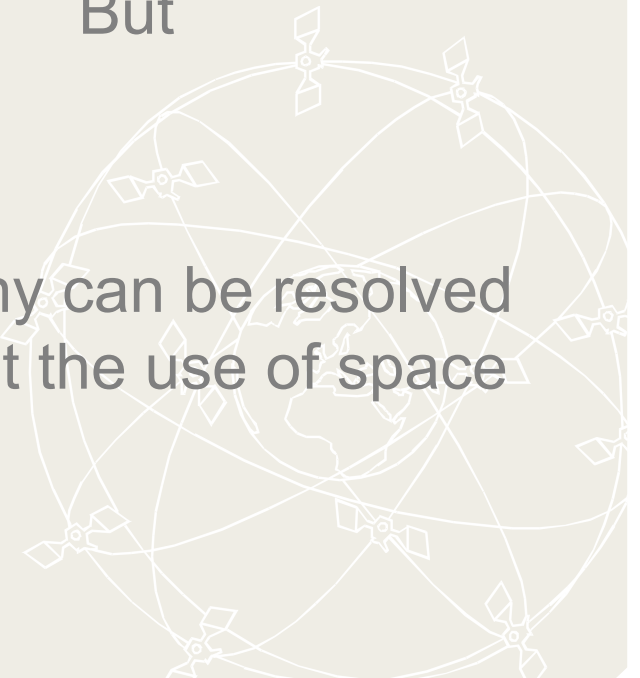
My Mantra for Space



Few, if any of the global challenges can be resolved by space alone

But

Few, if any can be resolved without the use of space



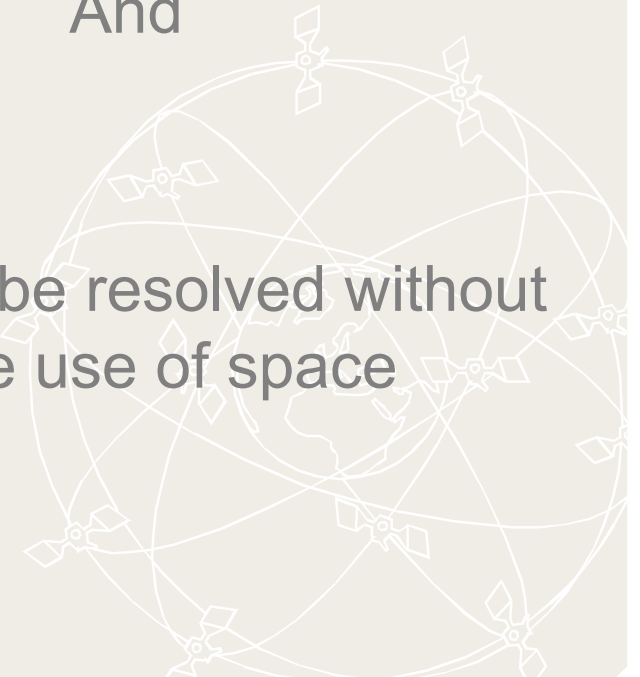
Conclusions



Some of the Arctic challenges
can be resolved by space
alone

And

None can be resolved without
the use of space







Magnificent and Vulnerable



Grand Challenges connected to the Arctic

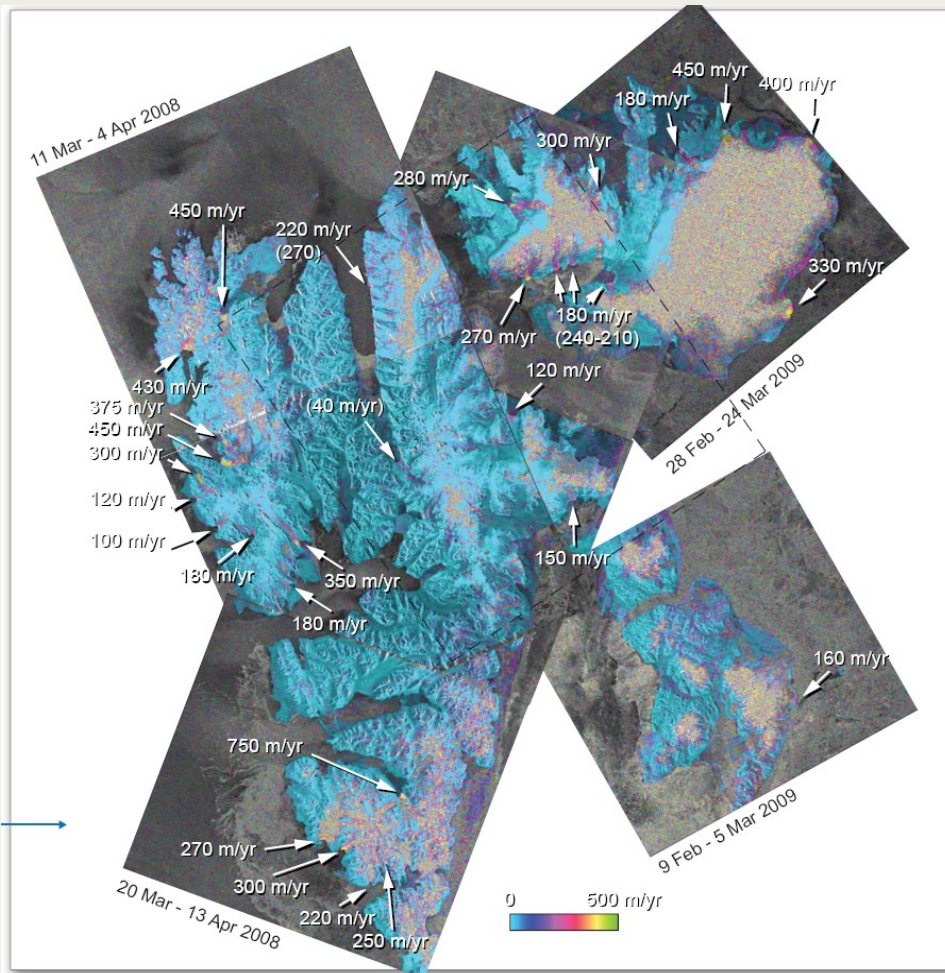


Earth System Science for Global Sustainability
The Grand Challenges



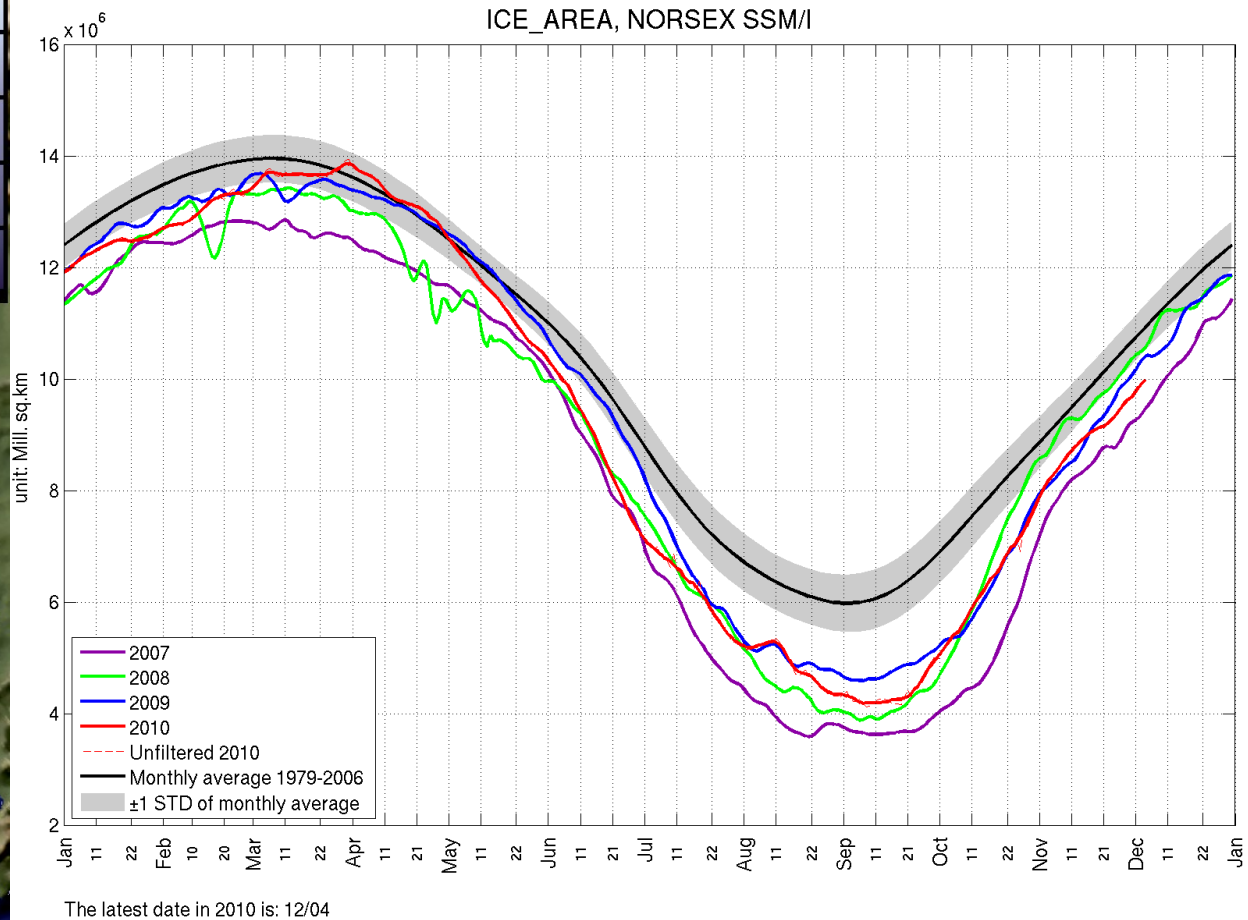
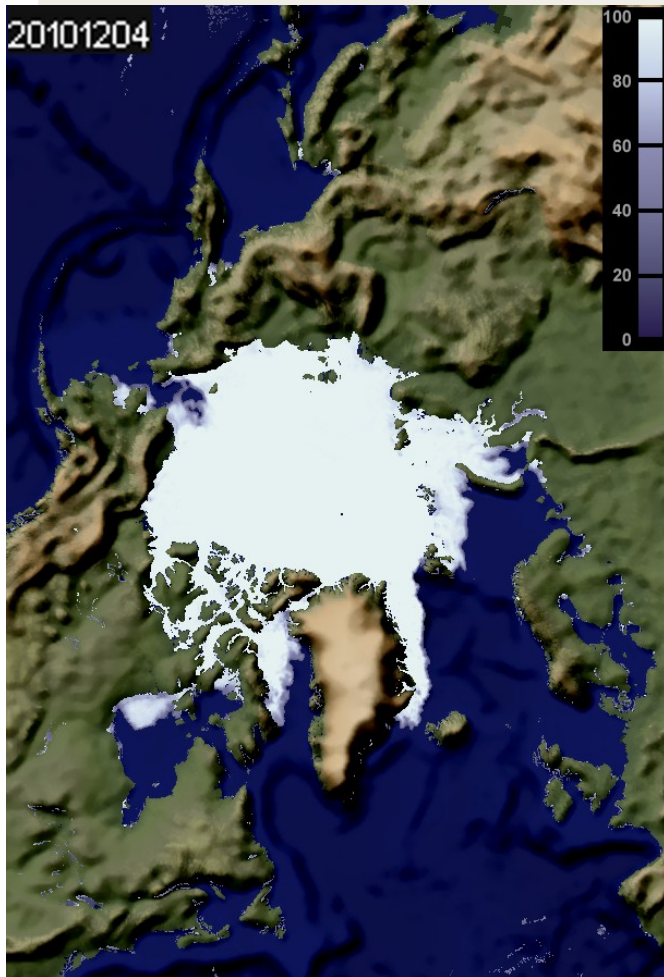
- Global processes originating in the Arctic.
- Science and observations only possible in and from the Arctic.
- Understanding and preserving an ecosystem at the brink.
- Sustainable management of renewable resources.
- Environmentally acceptable exploitation of other resources.

Climate Change and the Arctic



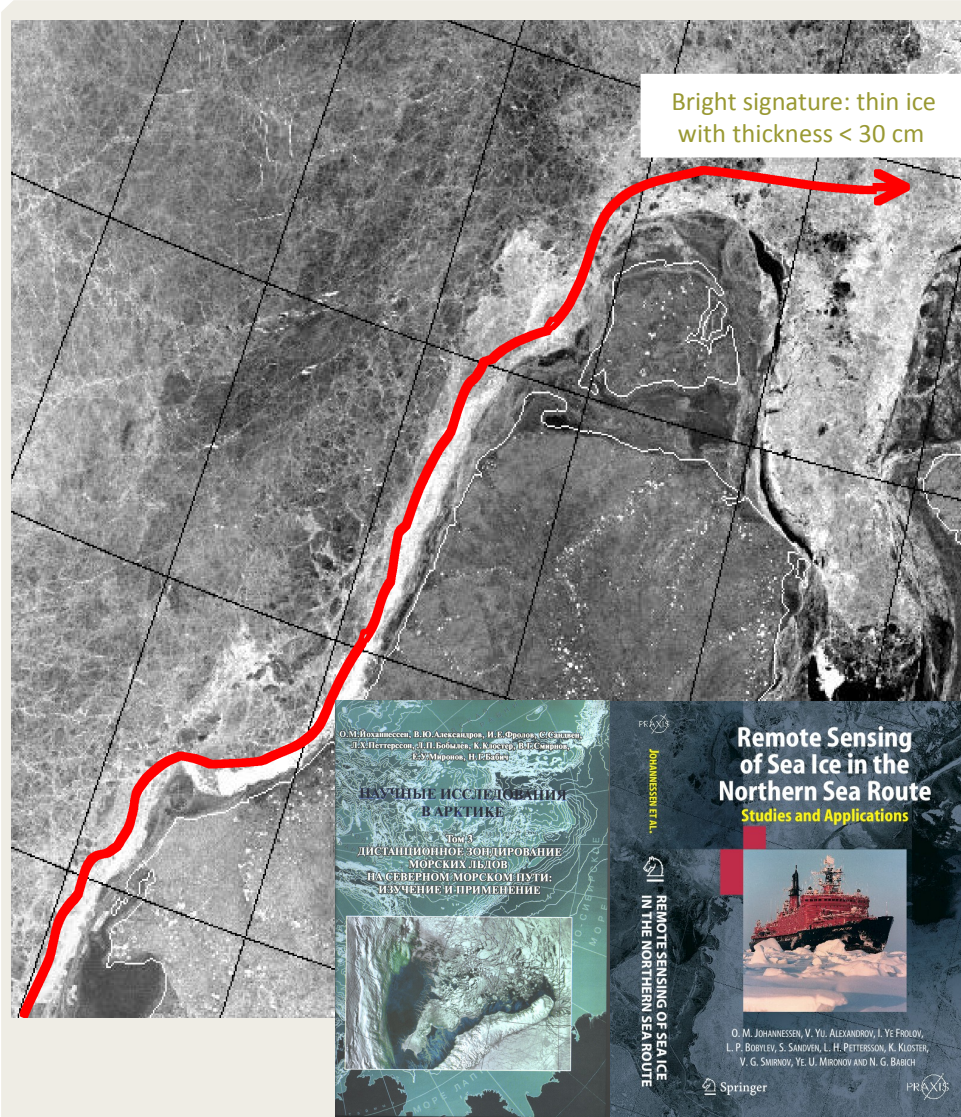
- Models indicate the largest effects in the Arctic, but the intrinsic variability is also the largest.
- Several potential climate tipping points have their source in the Arctic:
 - Sea ice cover and mass
 - Thermohaline circulation
 - Melting of major ice caps
 - Methane in sea or on land
 - Permafrost
- Long term monitoring of these parameters essential for the understanding of climate change.

Arctic sea ice area as of 4.December 2010



<http://Arctic-ROOS.org>

Other Environmental Challenges in the Arctic



➤ Recipient of pollution from human activity elsewhere:

- Accumulation in food chain
- Direct toxicity
- Black Carbon

➤ Increased human activity in the Arctic will increase internally caused environmental impact:

- Transport in general
- Tourism
- Oil and gas production
- Fisheries
- Other resource exploitation

The Arctic is not just for the Arctic

Maritime jurisdiction and boundaries in the Arctic region



www.durham.ac.uk/ibru

- ✂ Governance is given by the sovereign states and international treaties (eg International Law of the Seas).
- ✂ But, due to Global impact of and on, as well as Global Commercial interest in the Arctic:
 - Pollution sources outside
 - New shipping routes
 - Climate Change feedbacks and sources
 - Pristine areas
- ✂ All countries have, and should have legitimate interests in issues of the Arctic.

2010: Northern Sea Route and the Northwest Passage were ice-free in September

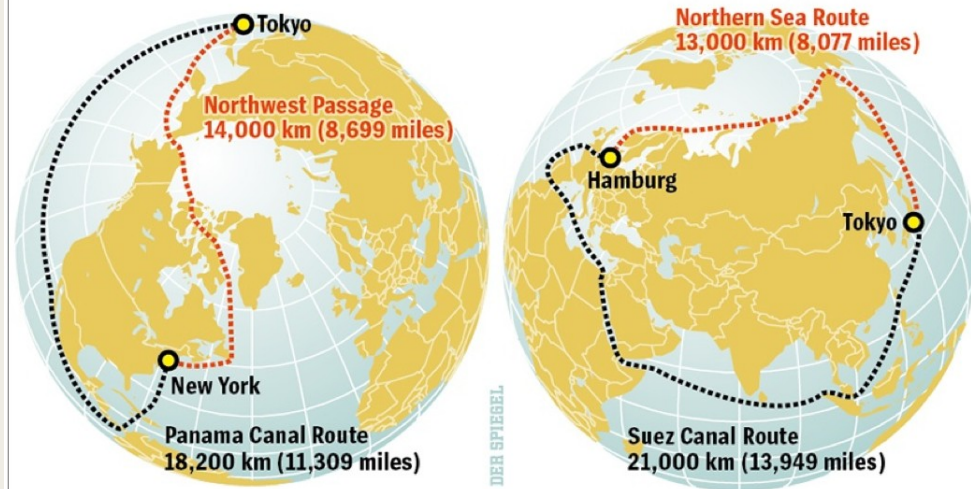


NERSC uses daily passive microwave data to map ice concentration along the sailing routes

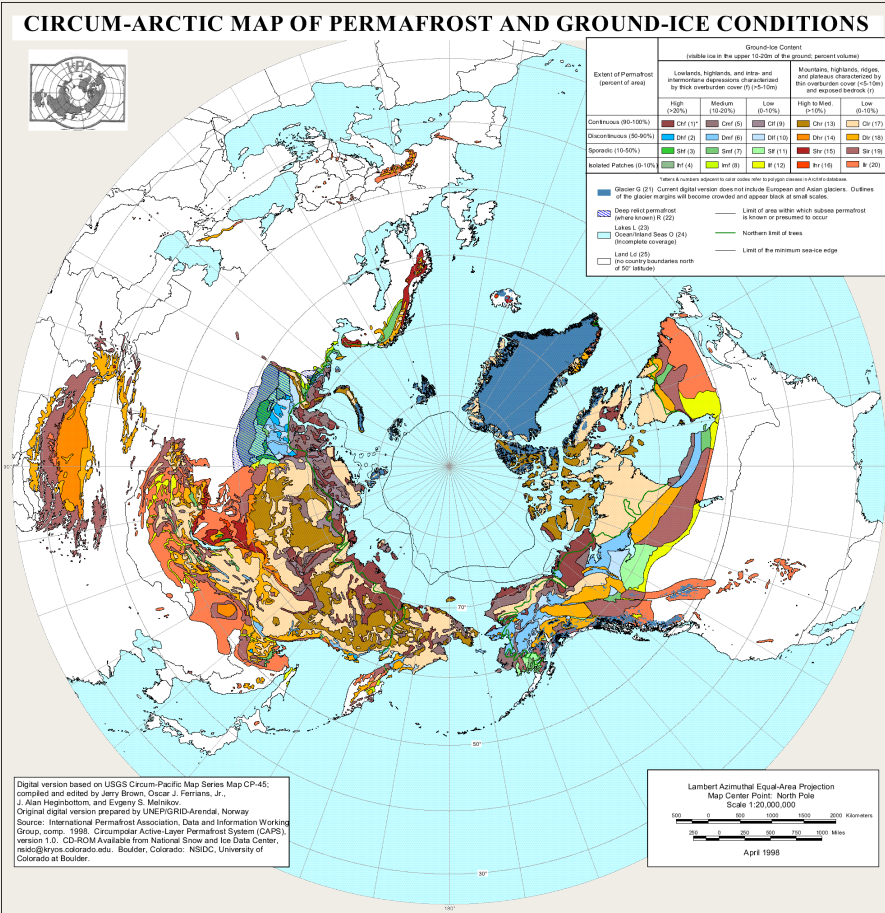
This ice map is from 08 September 2010

An Ice-Free Route to Asia?

Possible shipping shortcuts through the Arctic Ocean

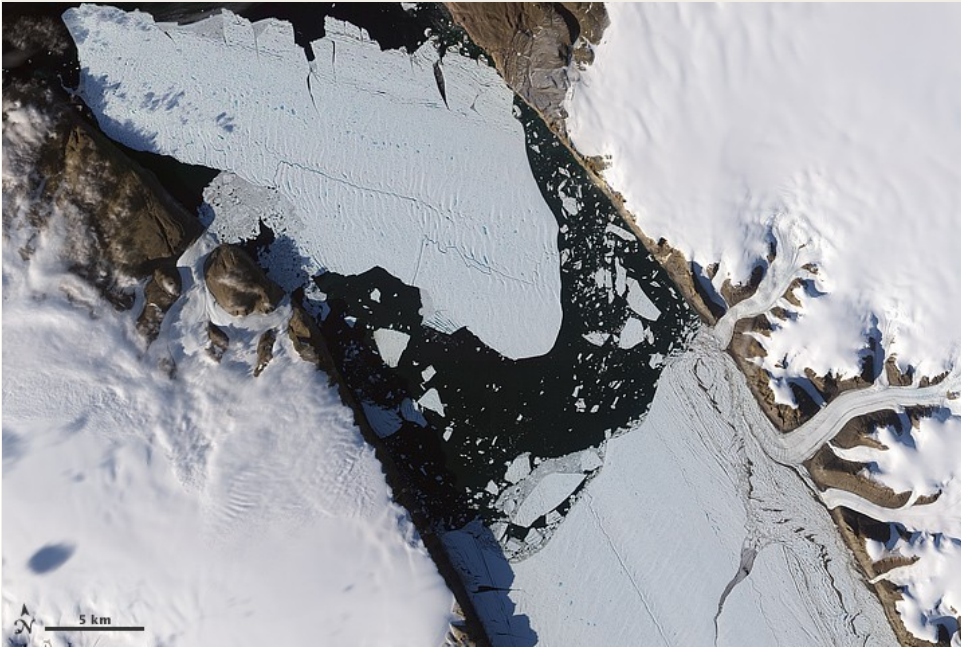


Space Observational Needs for the Arctic

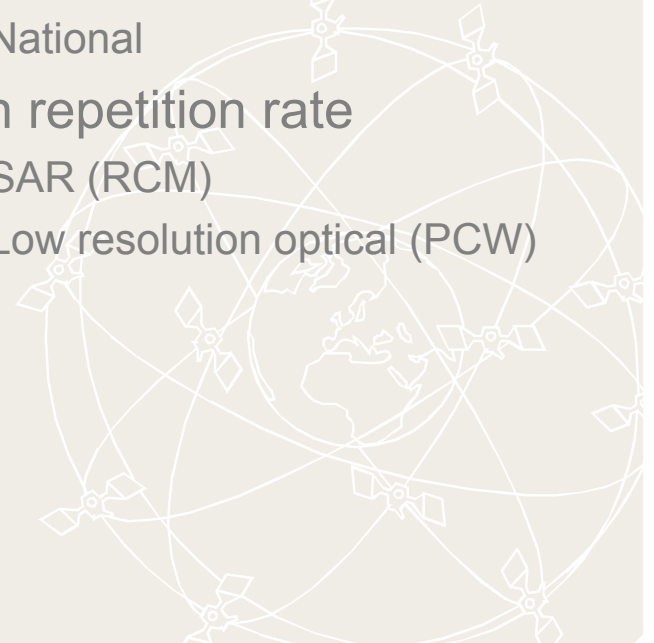


- ✦ Sea Ice extent/volume
 - ERS, ENVISAT, CryoSat, S-1
- ✦ State of the ocean
 - GOCE, SMOS
- ✦ Ice caps
 - GOCE, ERS, ENVISAT, GMES
- ✦ Atmospheric pollution (S-5 P)
- ✦ Permafrost (?)
- ✦ Upper atmosphere and geospace
 - Sounding rockets, ground instrumentation, science satellites
- ✦ Ice drift (transport, fisheries, oil & gas)
- ✦ Vessel monitoring and rescue services (AIS, radar, Galileo)

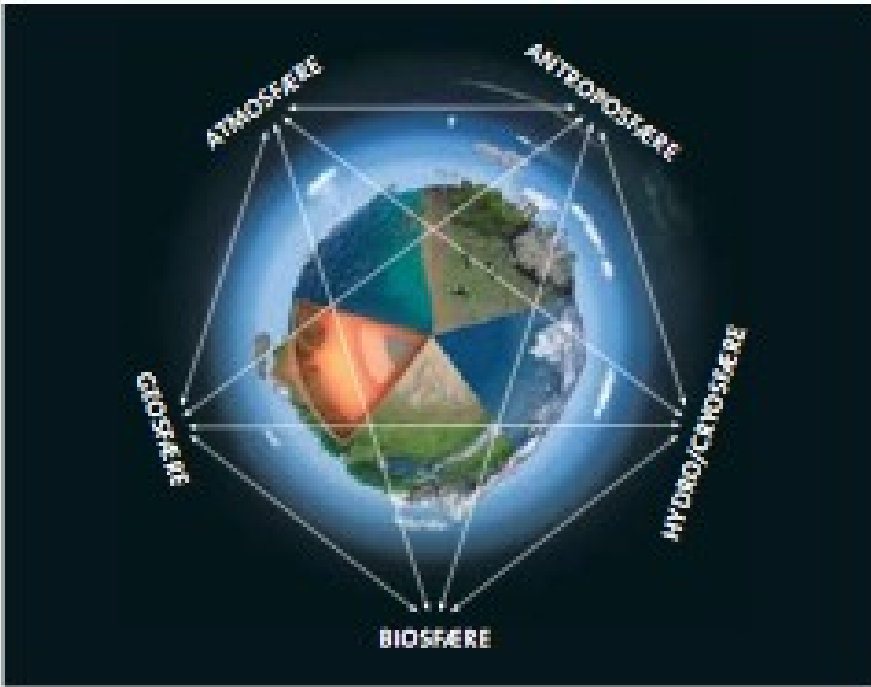
Additional Important Information



- ✦ High resolution optical
 - Commercial
 - GMES
- ✦ High resolution SAR
 - National
- ✦ High repetition rate
 - SAR (RCM)
 - Low resolution optical (PCW)



How to meet observational requirements?



- ❏ GOCE, CryoSat and SMOS deliver extremely important data, but there is no data continuity.
- ❏ GMES and RCM will be essential for some of the information and provide some data continuity.
- ❏ Realistically, neither ESA, EU nor the member states will have the resources to provide the required data continuity.
- ❏ International collaboration will be required, US, Canada, Japan ++
- ❏ GEO is a useful tool, but Europe has to take at least one more commitment for data continuity.

Conclusions

- ✦ The Arctic is an area of global significance as for environment and climate change, as well as for natural resources and tourism.
- ✦ Space infrastructure and space provided information is essential for understanding the governing processes as well as for management.
- ✦ Europe has provided essential infrastructure, but data continuity lacks for many important parameters. Lead on Cryosat continuity?
- ✦ International collaboration is needed, but Europe has to take responsibility, in an Arctic programme or within the EO programmes
- ✦ Space based information infrastructures needed to support all kinds of human activities in the Arctic (navigation and communication covered later).



The Definition of what we are talking about

